NOTES ON HYACINTH ROOTS.

BY IDA A. KELLER.

Last October I purchased a dozen hyacinth bulbs which were said to be specially selected and intended for water-culture. They were placed in appropriate glasses and treated according to approved methods; that is, they were kept in the dark during the following eight weeks. At the end of that time six had produced extensive root systems, five showed but a meagre development in this respect and had begun to decay, the odor being extremely offensive. I was about to dispose summarily of the weaklings when I determined to give them another trial. I carefully removed the decayed tissue and washed the bulbs with a solution of listerine. The odor soon disappeared and in a short time roots began to form. Soon other bulbs began to decay and they were treated in like manner, and then they also proceeded to form new roots. I had no success with hyacinth culture, but I believe the fault lay in the bulbs, which seemed to fail quite generally during the season. In no case did I see the flower stalk push out with that fine vigor which is so characteristic of the well-formed bulb. Even the six plants above referred to with the normal root-system, which indeed had become so extensive that it made a heavy mat in the bottom of the glass, produced nothing but a much-shriveled flower stalk with the blooms wilted before they had an opportunity to expand. In these cases, however, the leaves unfolded quite normally.

Although convinced that the bulbs were not worth keeping for the purpose of floral display, I continued watching them, having become interested in the formation of the new roots. Some of these were particularly thick and vigorous, and differed greatly in appearance from those which are normally first formed. They seemed to be a second crop of adventitious roots, the first formed also belonging to this category since they originate from mature tissue of these metamorphosed stems. Some slender roots were

also formed, but the thick roots were far the more numerous. On one of the bulbs whose original roots had all decayed and which I had treated in the manner described above, thirty such roots had made their appearance with not a single slender root among them (Plate XIII, fig. 1). On the six healthy plants with normally developed root-systems, some of these thick roots were to be found after some time among the first formed more slender roots, and both continued alive (figs. 2 and 3).

Is this secondary formation the expression of a more vigorous growth of the plant which follows with the expansion of the foliage, or is it due to the greater need because of the increase of the transpiring surfaces? Perhaps both of these factors come into play as they both bear a direct relation to root development—the foliage depending entirely upon the absorbing action of the roots; the roots, in their turn, being the result of the protoplasmic activity of the leaves.

I endeavored to discover whether these roots differed in their anatomical structure from those first formed. A great difference was not to be expected, since roots, in general, are of very uniform construction These organs seem particularly indisposed to variations in the relative positions and character of their elements.

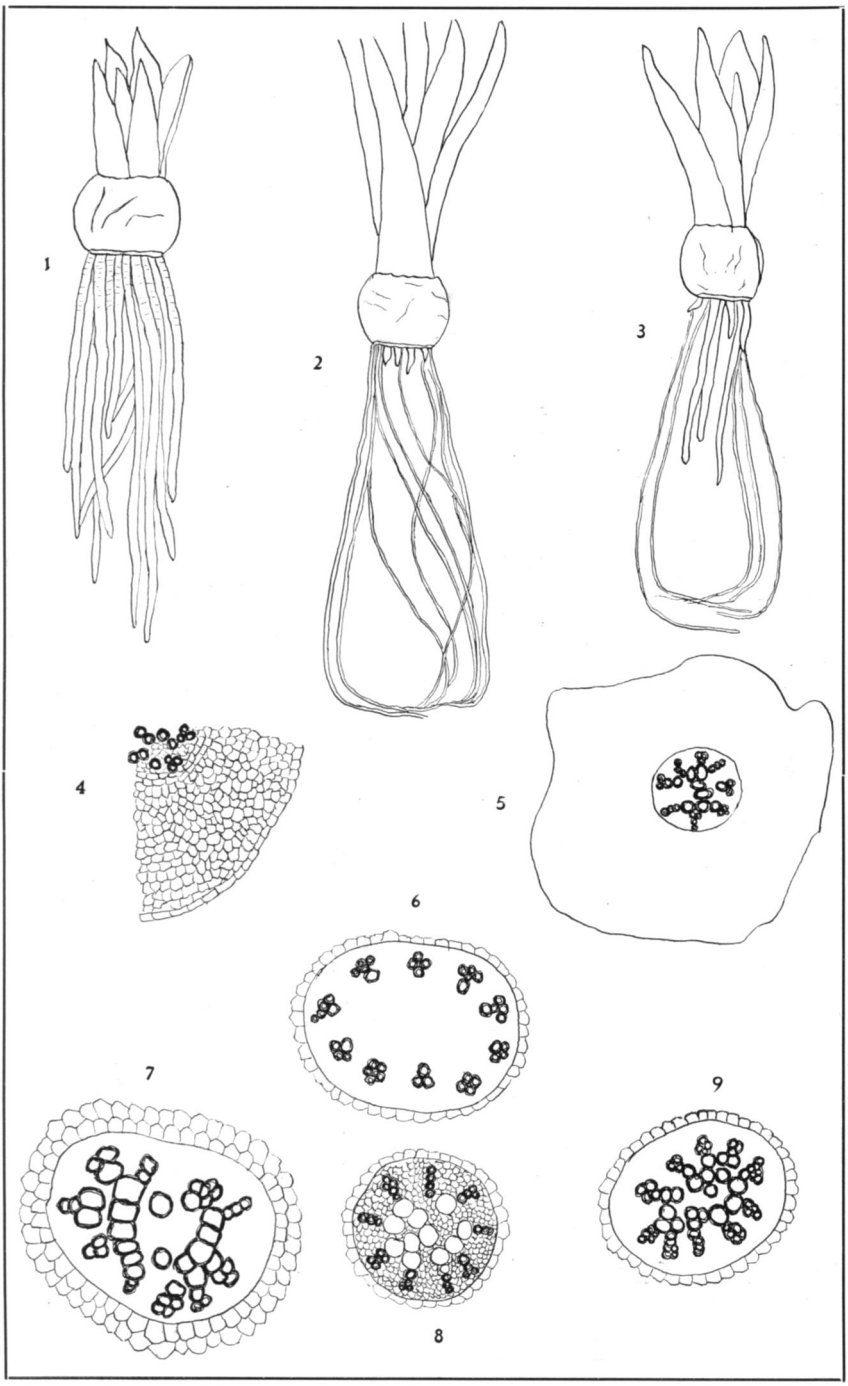
A cross section of an ordinary root showed the usual arrangement—the epidermis, the cortical parenchyma, the endodermis, and the central cylinder with its axillary bundle of fibrovascular tissue, a little distorted, but with a hexarch radial structure, the six very small component bundles converging to the centre, and separated from each other by a few interstitial cells (Plate XIII, fig. 4). Further examination showed that there was some variation in the number of these bundles. In fig. 5 the bundles converge toward two wide vessels, and a tendency to a diarch arrangement is quite pronounced, the rays forming two more or less distinct masses. In a cross section of the *thick* roots near the base this diarch arrangement was quite plain; there are two distinct bands of vascular tissue (fig. 7).

The polyarch radial structure was striking in a cross section about one and a half inches from the base and at this point there was no trace of a diarch tendency. This is probably the result of later development. In this section are to be found ten groups of vascular tissue, with a comparatively large quantity of

undeveloped tissue in the centre (fig. 6). This is quite usual in roots, the tissue in the centre remaining in an undeveloped state for a time after the peripheral vessels are fully developed. Cross sections such as shown in fig. 8 illustrate this point clearly. The large circular spaces represent the lumina of vessels with as yet unthickened walls.

Comparison of the drawings will show to what extent these two kinds of roots differed from each other in their histological elements. The greatest difference lies in the relative quantity and development of the vascular tissue. On counting the number of cells in the cortical parenchyma I found that, in the cross section represented in fig. 4, that of the thread-like root, there were ten layers of cells, while in the cross section represented by fig. 7, that of a thick root, there were twenty cells in the corresponding tissue, just double the number. Of course here also variations were to be found, but this was an average.

These thick roots were particularly good objects for the study of root structure and development. They are easy to section and show interesting variations in their radial symmetry.



KELLER. HYACINTH ROOTS.